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Analysis of the trend of mortality from HIV/AIDS according to sociodemographic characteristics in Brazil, 2000 to 2018

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Abstract *This investigation analyzed the trend of HIV/AIDS mortality by sociodemographic characteristics in the Brazilian states from 2000 to 2018. This is an ecological study of time-series of standardized rates of mortality from AIDS overall, by gender, age group, marital status, and ethnicity/skin color, employing the Prais-Winsten generalized linear model. The results showed that the states with the highest rates were Rio Grande do Sul, Rio de Janeiro, São Paulo, and Santa Catarina. The trend was increasing in the North and Northeast. Men had higher rates than women and the general population. The most advanced age groups showed a growing trend. The analysis by marital status showed higher and growing rates among the unmarried. Blacks had higher rates, except for Paraná, with a mainly increasing trend. Mortality due to HIV/AIDS had different trends by sociodemographic characteristics, with a need for preventive and care actions for men, adults, older adults, unmarried, and black people due to the change in the mortality profile.*

Key words *Mortality, HIV, Acquired Immunodeficiency Syndrome, Time-series studies*

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Introduction

Some 690,000 deaths from HIV/AIDS were recorded in the world in 2019, with a 39% drop in global deaths from 2010 to 2019[1]. Brazil recorded 349,784 deaths from HIV/AIDS from the early 1980s until December 2019, with a drop in the country's mortality rate from 2009 to 2019. This pattern was not found in the states of Acre, Pará, Amapá, Maranhão, Rio Grande do Norte, and Paraíba, which showed a resurgence of this disease[2]. Also, HIV infections affect mostly males, young people aged 20-34 years, and blacks[2].

This epidemic seems to be concentrated in specific places. However, it is heterogeneous when observing the increase in part of the states and municipalities[3]. The concentrated hike in mortality from HIV/AIDS in some places can be explained by the sociodemographic features of the population[4,5], such as gender, age group, marital status, and ethnicity/skin color.

One study comparing the registration of mortality from HIV/AIDS in Brazil in the Mortality Information System (SIM) and the global burden of the disease showed that mortality from HIV/AIDS needs attention and, regardless of the methods applied in the studies, mortality from the disease shows significant rates and are a matter of concern[6].

The temporal analysis of HIV/AIDS mortality in Brazilian states based on gender, age group, marital status, and ethnicity/skin color is essential as it cements knowledge about the profile of death from HIV/AIDS and directs actions to control the advance of the disease.

Updated studies that encompass these variables together, especially concerning the marital status and ethnicity/skin color, are not observed in the literature since existing investigations focus on mortality from the disease based on overall mortality coefficients and do not consider other characteristics that could increase knowledge of the profile of the disease's occurrence from a sociodemographic perspective.

In light of the above, this study aims to analyze the trend of mortality from HIV/AIDS in Brazil and Federative Units by sociodemographic characteristics from 2000 to 2018.

Methods

This is an ecological time-series study on HIV/AIDS mortality rates, with data from the Mortality Information System (SIM). All deaths from HIV/AIDS in Brazil from 2000 to 2018 were included in the study.

Deaths related to HIV/AIDS whose International Disease Code (ICD) refers to the range B20-B24 were considered to calculate mortality rates per 100,000 inhabitants. The standardized overall mortality rates by gender, ethnicity/skin color, and marital status were calculated using the direct method, and the 2010 Brazilian population was established as the standard. Mortality rates for HIV/AIDS by age group were also presented.

The information on the resident population used to calculate the HIV/AIDS mortality rates overall, by gender, and age group from 2000 to 2018 corresponds to the population estimates available on the DATASUS website in demographic and socioeconomic information.

Populations by ethnicity/skin color and marital status were extracted from the Brazilian Institute of Geography and Statistics (IBGE) through the IBGE Automatic Recovery System (SIDRA) by searching the API on this site and the SidraR package contained in the RStudio statistical program. These populations are only available for 2000 and 2010. Therefore, it was necessary to estimate them from the calculation of the population growth rate to identify the populations from 2001 to 2009 and from 2011 to 2018. The black and brown categories were merged in the black group, while the indigenous and yellow categories were excluded from the analysis due to their negligible number.

The trend analysis was performed using the Prais-Winsten[7] generalized linear analysis model, where the independent variables (X) were the years of deaths and the dependent variables (Y) were the mortality rates. The value of b0 refers to the intersection between the line and the vertical axis, while the value of b1 represents the line's slope. This value allowed us to estimate the Annual Percentage Change (APC). It is necessary to apply the logarithmic transformation of the Y values (mortality rates) to measure this rate.

The application of the logarithmic transformation allows reducing the heterogeneity of variance of the regression analysis residuals. When the APC is positive, the time-series is classified as increasing, while it is decreasing when negative. The time-series will be stationary when there is no significant difference between its value and zero[7]. Data organization, rate calculation, trend analysis, maps, and charts were performed using the RStudio version 4.0.2 program, and the level of significance of 5% was considered for trend analysis.

This study used freely available secondary data and did not directly involve human beings, thus not requiring submission to the Research Ethics Committee (CEP).

Results

Brazil recorded 222,205 deaths from AIDS from 2000 to 2018. Among these deaths, 580 (0.3%) had no information on the age group, 40 (0.02%) did not show gender-related data, 13,709 (6.2%) had no registered ethnicity/skin color data, and 19,065 (8.6%) had no record of marital status. Data that did not have records were excluded from the analysis.

Brazil had higher standardized mortality rates for males. Overall and female mortality rates had similar values. Rates varied in the states, with the highest values observed in Rio Grande do Sul, Rio de Janeiro, São Paulo, and Santa Catarina. Most states had higher rates among males; only Acre and Tocantins showed higher rates among females in some points of the series (Figure 1).

Mato Grosso had similar rates until 2015, with a wide discrepancy in subsequent years. Amapá showed similar rates throughout the period, while São Paulo and Rio Grande do Sul had more accentuated rate falls. On the other hand, Amazonas, Pará, and Maranhão had increased rates over the period (Figure 1).

Trends were decreasing in Brazil for overall mortality and male/female. Most states in the North and Northeast had an increasing trend towards different stratifications. The South, Southeast, and Midwest states showed steady and decreasing trends in the period for the general population and both genders (Figure 1).

In Brazil, the most significant rates were found in the 30-59 years age group, with a resurgence among those aged 60 and over. However, trends decreased in the 0-14 years, 15-29 years, and 30-59 years age groups and increased in the 60 years or more age group.

In the federative units, rates by age were also more significant in the 15-29 years, 30-59 years, and 60 years or more age groups. However, those aged 30-59 years were more prominent, with an increase in Amazonas, Amapá, Paraíba, Pernambuco, and the Federal District, with a decline in Rio de Janeiro and Paraná. Also, increased rates were observed in the states among those over 60 years of age, with important variations in Roraima and Amapá.

Trends were mainly decreasing and stationary in most states, with an increasing trend only observed in Rondônia. In the 15-29 years age group, the North and Northeast showed increasing trends, and stationary trends were only observed in Acre, Roraima, Tocantins, Paraíba, Pernambuco, and Bahia. In those aged between 30-59 years, trends were increasing or stationary in the North and Northeast, except for Acre. Only Minas Gerais had an increasing trend in the Southeast region, while the other states in this region had stationary or decreasing trends. The age group of 60 years or more showed a growing trend in most Brazilian states, except for Acre, Amapá, and the Federal District (Figure 2).

In Brazil, standardized mortality rates by marital status were higher among the unmarried, but trends were declining in both categories (Figure 3). Mortality rates by marital status were higher among the unmarried in the states of the federation. Amazonas, Pará, Maranhão, Pernambuco, and Bahia had growing rates over the years. On the other hand, despite the higher rates, Minas Gerais, Rio de Janeiro, São Paulo, and Santa Catarina decreased over the years. Trends among the unmarried were increasing in most states in the North and Northeast. The trend was declining or stationary in the other states of the country. Trends were increasing in only two states among married couples: Rondônia and Tocantins. Trends were stationary or decreasing in other states (Figure 3).

Mortality rates standardized by ethnicity/skin color in Brazil were more significant among whites from 2000 to 2005, with a subtle rate overlapping for blacks. Trends in the period were decreasing among whites and stationary among blacks (Figure 4).

Mortality rates by ethnicity/skin color showed different patterns when the states were verified. Paraná was the only one with higher mortality rates among whites. Mortality rates between blacks and whites showed similar rates in São Paulo, Santa Catarina, Mato Grosso do Sul, Goiás, and the Federal District. It is noteworthy that Pará and Pernambuco had higher rates from 2000 to 2018. Rio Grande do Sul and Rio de Janeiro showed higher rates among blacks (Figure 4).

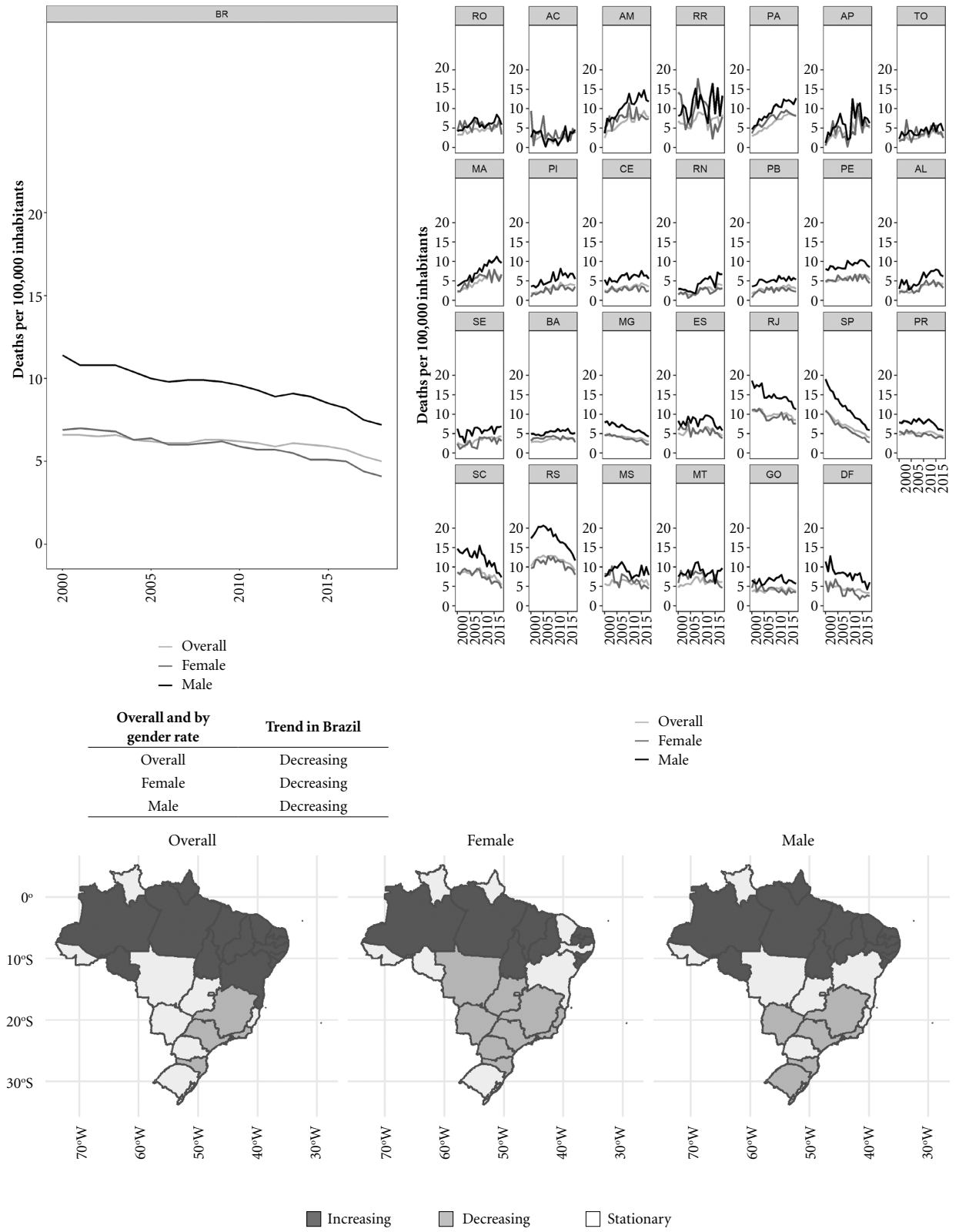
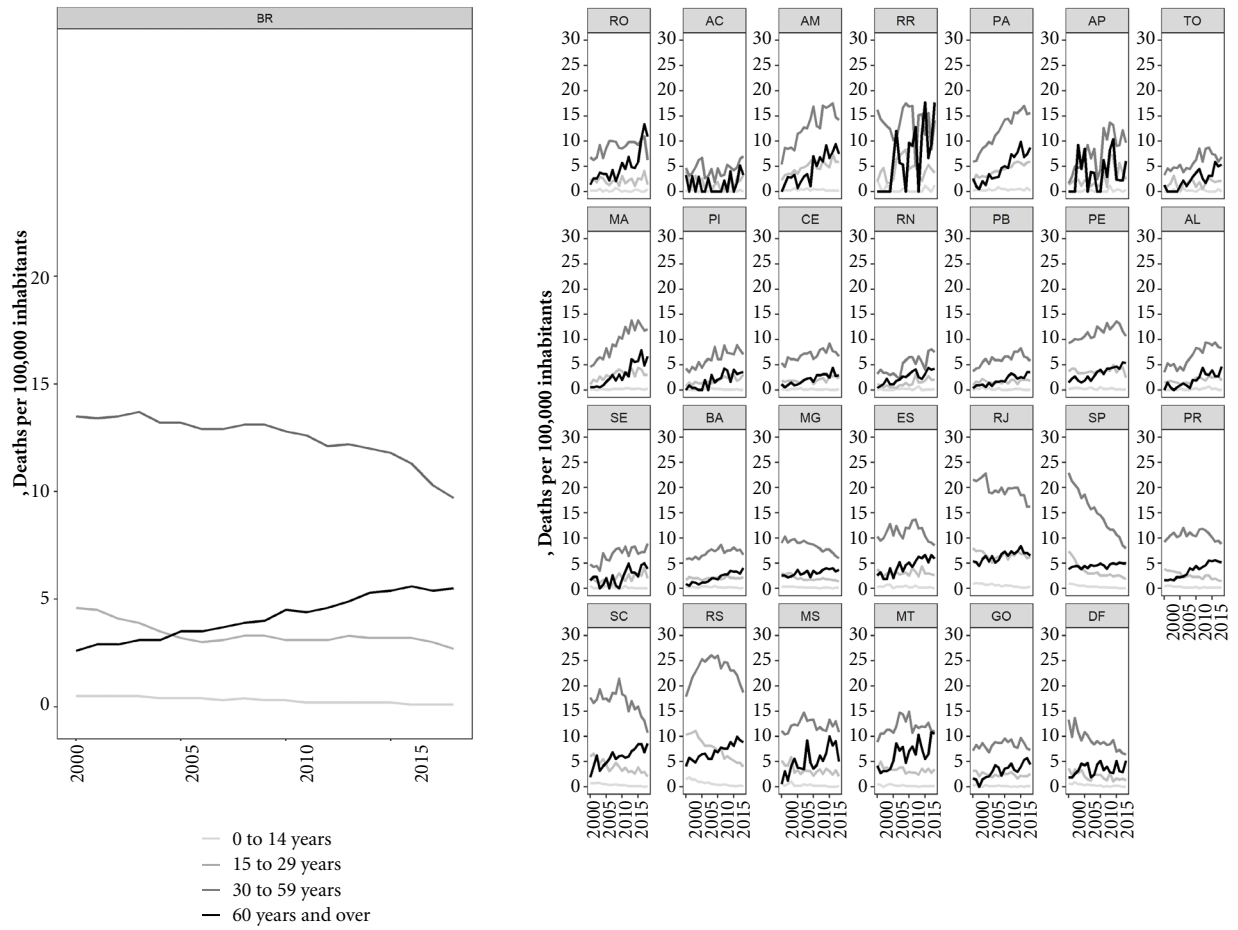


Figure 1. Standardized rates and trends in HIV/AIDS mortality overall and by gender in Brazil and Federative Units, 2000 to 2018.

Source: SIM, 2020; IBGE, 2020.



Rate by age group	Trend in Brazil
0 a 14 anos	Decreasing
15 a 29 anos	Decreasing
30 a 59 anos	Decreasing
60 anos ou mais	Increasing

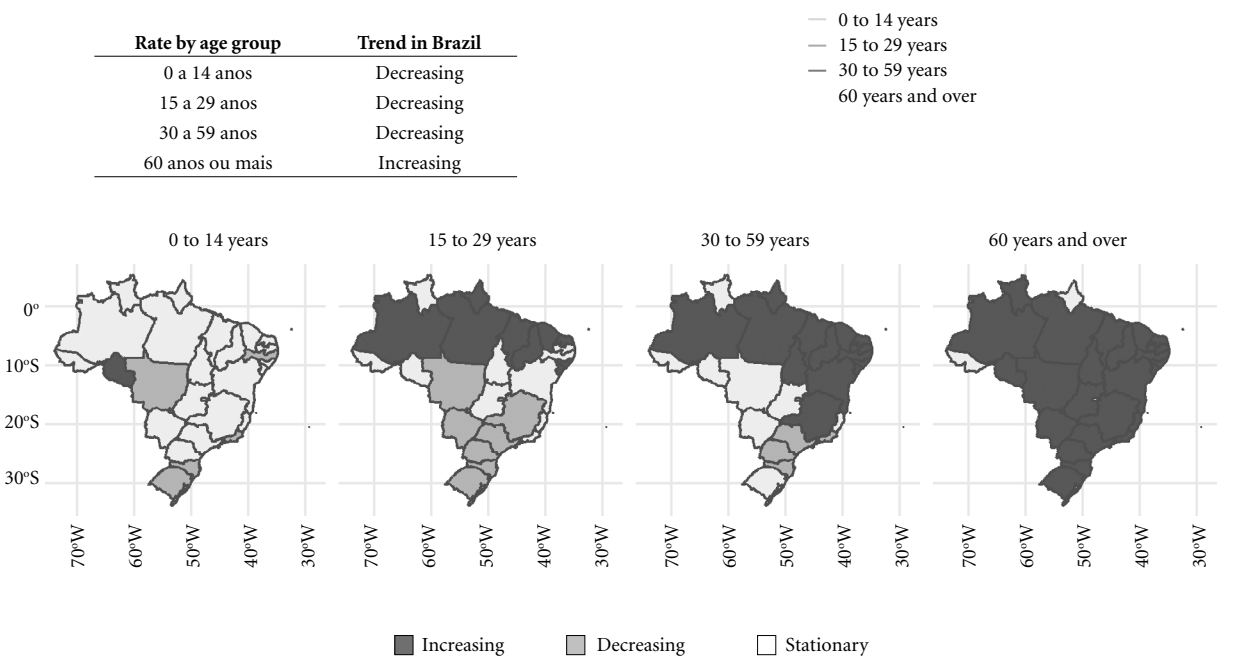
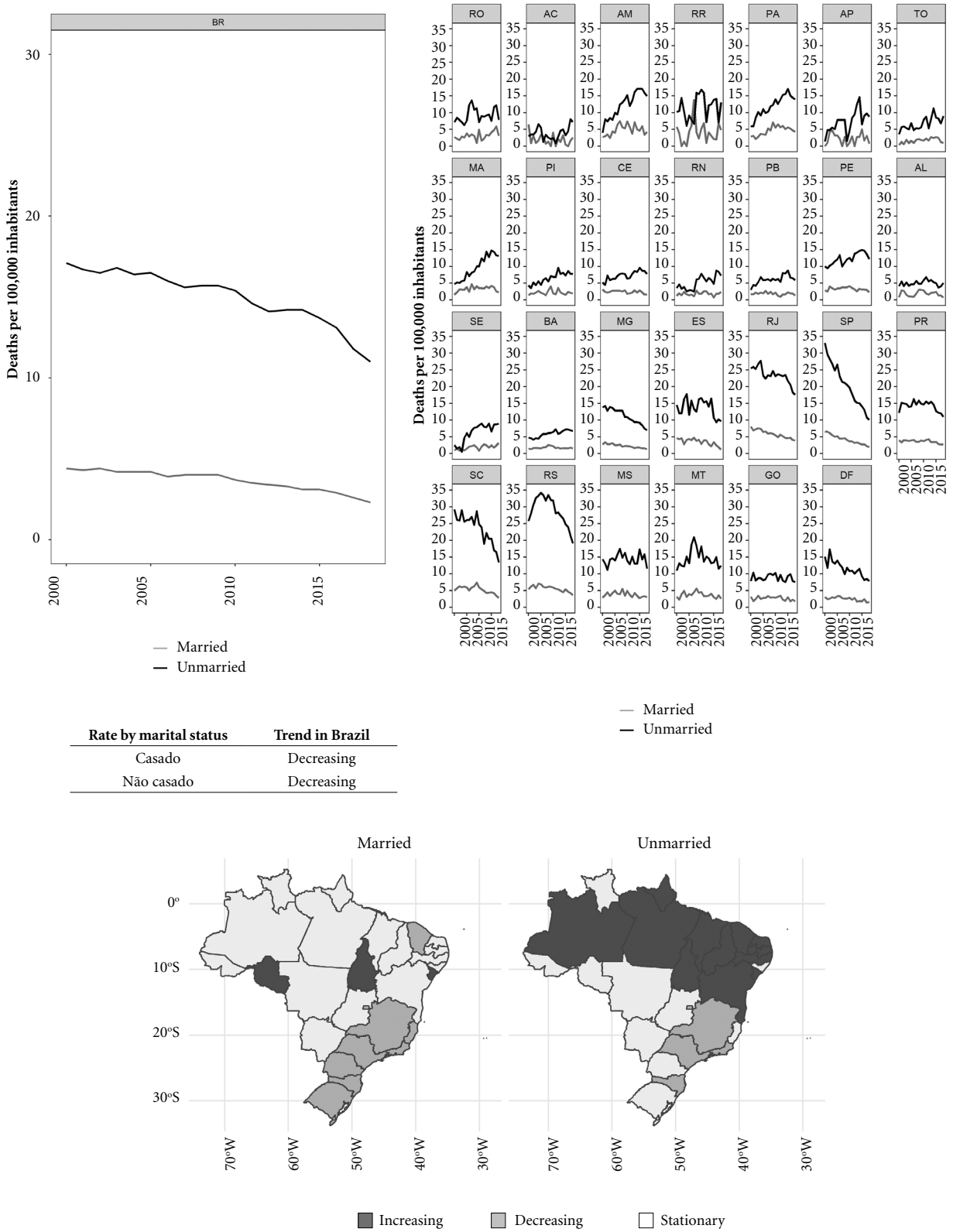


Figure 2. Standardized rates and trends in HIV/AIDS mortality by age group in Brazil and Federative Units, 2000 to 2018.

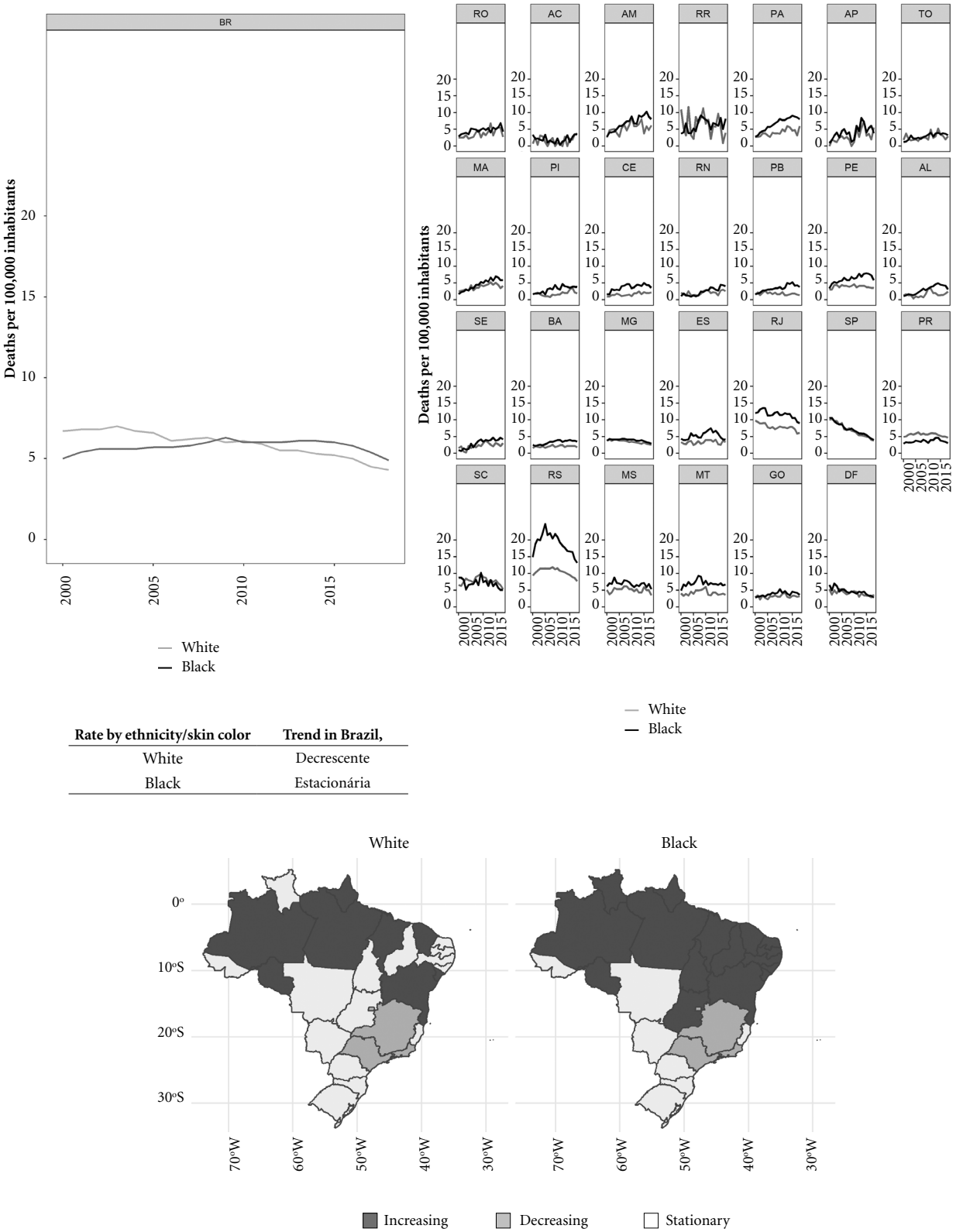
Source: SIM, 2020; IBGE, 2020.



Rate by marital status	Trend in Brazil
Casado	Decreasing
Não casado	Decreasing

Figure 3. Standardized rates and trends in HIV/AIDS mortality by marital status in Brazil and Federative Units, 2000 to 2018.

Source: SIM, 2020; IBGE, 2020.



Rate by ethnicity/skin color	Trend in Brazil,
White	Decrescente
Black	Estacionária

Figure 4. Standardized rates and trends in HIV/AIDS mortality by ethnicity/skin color in Brazil and Federative Units, 2000 to 2018.

Source: SIM, 2020; IBGE, 2020

Blacks had a more significant number of states with an increasing trend than whites. It is noteworthy that the mortality trend was growing in blacks in all states in the North and Midwest, except for Acre. The trend was also increasing in some states among whites, with a concentration in the North and Northeast (Figure 4).

Figure 5 represents the annual percentage changes (APC) and confidence intervals, showing that the South, Southeast, and Midwest states showed variations that point to a fall or stationarity. The states of the North and Northeast showed mainly growing variations.

Discussion

The study on the Brazilian trend of mortality from HIV/AIDS found that the rate was increasing only among those over 60 years of age and stationary among blacks and decreasing in the other categories of analysis. The pattern of falling mortality from the disease in Brazil was also observed in other studies[2,8].

The results of this study point to differences in mortality trends in the states of the North and Northeast, with increasing trends concentrated in these locations. The literature points out that greater attention is required in the North and Northeast as there is an upsurge in mortality, incidence, and prevalence[3,6,9,10], also noting that the shortage of specialized services and late access to treatment leads to a higher probability of low adherence to the treatment of People Living with HIV/AIDS (PLWHA), which aggravates the disease setting in these places[10-12].

The high mortality rate in males is also observed in national and international studies, which show that men are more affected by HIV/AIDS[13-18]. Men are at greater risk of reaching an advanced stage of the disease and also starting treatment later than women[19,20].

The analysis according to females indicates that the North and Northeast regions have an increasing trend among women, although the rates among women are not as expressive as males. Some factors that can justify this situation are the unequal conditions that women are exposed to daily and also make them vulnerable to HIV/AIDS, such as an environment permeated by submissive practices that influence their choices regarding sexual practice, abusive relationships characterized by violent situations, difficulties in accessing diagnostic services, and poverty[21-27].

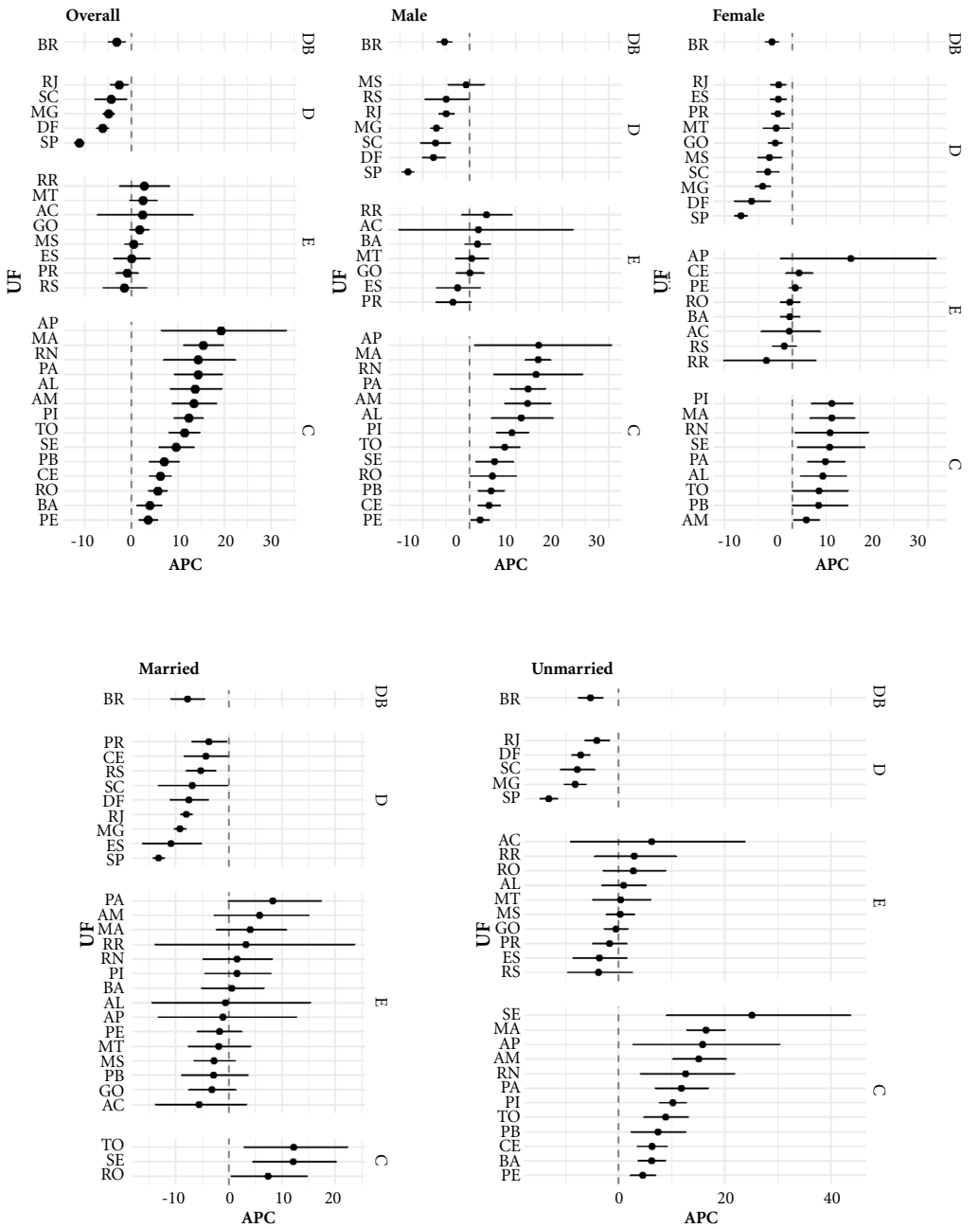
Mortality from HIV/AIDS by age group showed a decreasing trend among children and adolescents, which was also observed in a study that assessed mortality in this population from 1990 to 2016[28]. On the other hand, this trend has progressed accordingly with the aging of PLWHA, which can be seen with the higher number of states with an increasing trend with age, a pattern that was also identified in surveys carried out in Brazil and Iran[15,29-31]. Other factors may contribute to higher rates at older ages, such as Antiretroviral Therapy (ART), which increased life expectancy of PLWHA and advanced HIV diagnosis in the older population[32-35].

Mortality rates by marital status are more significant among unmarried people, as found in other studies[36-38]. It was found that people in stable relationships have less vulnerability to HIV/AIDS and greater adherence to treatment[39,40]. Also, being married and having a high educational level can contribute to fighting the infection, reducing the vulnerability of these people to HIV/AIDS, and helping to avoid the symptomatic form of the disease[41].

Concerning the analysis by ethnicity/skin color, blacks had similar rates but higher than whites, noting that blacks show increasing trends in many states. The findings of this study corroborate those of other studies[42-44]. The high rate among blacks may be related to a set of factors that place the black population in a situation of greater vulnerability to mortality from HIV/AIDS, as it is inserted in unfavorable living conditions and exposed to greater social vulnerability and access to services due to the prevailing structural racism[45-48].

This study has potential and advantages for using secondary data and providing relevant information to guide public policies but has limitations related to the incompleteness and inconsistency of the accessed data. The SIM data showed improvements due to the reduced registration of deaths from ill-defined causes, which causes an increase in specific mortality rates in those regions with significant registration of deaths from ill-defined causes, which is the case of the North and Northeast. From this scenario, it is essential to point out a possible underestimation of the rates at the onset of this study's period.

Another limitation of this study is the impossibility of analyzing the sexual orientation of people who died from the disease, as no such recording field is available in the SIM. This information would contribute to a better understanding of the epidemic's dynamics among populations vulnerable to the disease.



DB – Increasing trend in Brazil; EB – Decreasing trend in Brazil; CB – Increasing trend in Brazil; D – Decreasing trend; E – Stationary trend; C – Increasing trend; APC – Annual Percentage Change.

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Figure 5. Confidence intervals of HIV/AIDS mortality rates by sociodemographic characteristics, Brazil, and Federative Units, 2000 to 2018.

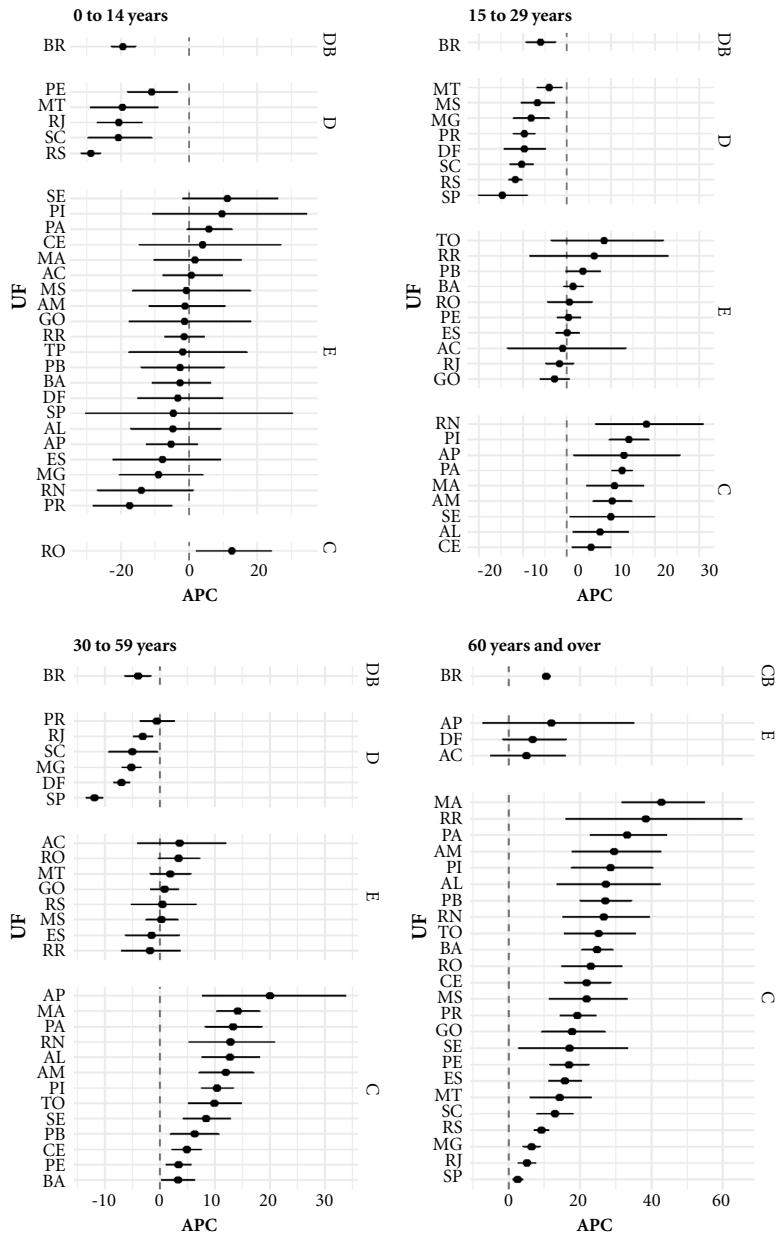

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Figure 5. Confidence intervals of HIV/AIDS mortality rates by sociodemographic characteristics, Brazil, and Federative Units, 2000 to 2018.

Mortality from HIV/AIDS is characterized as a complex event permeated by social issues that must be incorporated into HIV/AIDS response policies and programs in light of the change in this setting. Despite this need, there is still a significant focus on the biomedical model to face this epidemic, which contributes to the reinforcing inequalities in death from this disease because

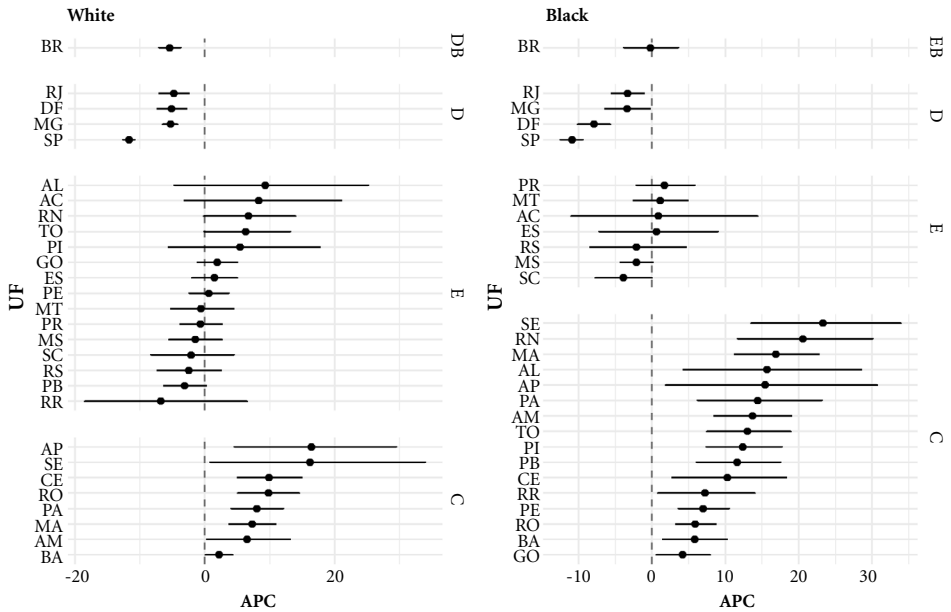

Figure 5. Confidence intervals of HIV/AIDS mortality rates by sociodemographic characteristics, Brazil, and Federative Units, 2000 to 2018.

Source: SIM, 2020; IBGE, 2020.

when there is no attention to issues that also contribute to vulnerabilities and the problem is not being addressed at its core, giving preference to strategies focused on the pathogen rather than the subject and their relationships.

Although it was not the object of this study, it would be essential to carry out studies that included living conditions to explain mortality from HIV/AIDS, which may be a way to visualize how inequalities are expressed socially, as epidemiological and social aspects of the places where one circulates can affect the health of individuals. It is also necessary to pay attention to differences in the characteristics of populations that can contribute to inequalities, and it is crucial to select relevant variables for the analysis of inequalities.

Finally, these findings can contribute to the planning and managing prevention and care actions in PLWHA care within the SUS. However, they point to the need to deepen knowledge of the factors that influence mortality from HIV/AIDS, such as access to services and the inclusion of living conditions to understand this dynamic at different scales.

Collaborations

AP Cunha contributed to the conception and design of the article, analysis and interpretation of data and writing of the manuscript. MM Cruz and MM Pedroso contributed to the analysis and interpretation of data and critical review of the manuscript. All authors have approved the final version and are responsible for all aspects of the work, including ensuring its accuracy and completeness.

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